Everyone is able to know where they are and

where other things are anytime, anyplace!

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

National Ocean Service

National Geodetic Survey

Positioning America for the Future

NATIONAL SPATIAL REFERENCE SYSTEM

The National Spatial Reference System (NSRS) is a consistent national coordinate system that specifies latitude, longitude, height, scale, gravity, and orientation throughout the Nation, as well as how these values change with time.

NATIONAL SPATIAL REFERENCE SYSTEM

ACCURATE -- cm accuracy on a global scale

MULTIPURPOSE -- Supports Geodesy, Geophysics, Land Surveying, Navigation, Mapping, Charting and GIS activities

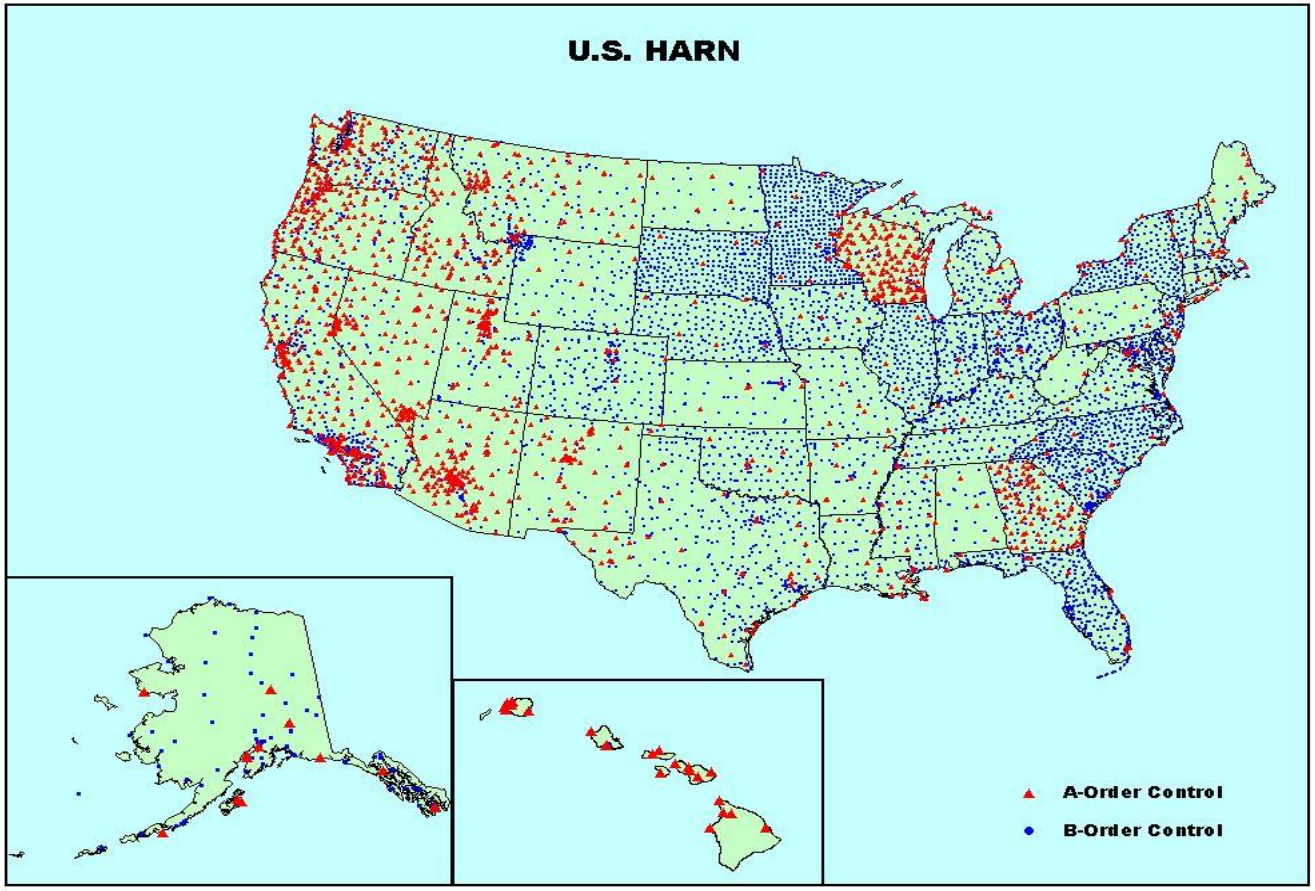
ACTIVE -- Accessible through Continuously Operating Reference Stations (CORS) and derived products

INTEGRATED -- Related to International services and standards (e.g. International Earth Rotation Service, International GPS Service etc.)

IMPROVING POSITIONAL ACCURACY

REFERENCE FRAME	TIME SPAN	NETWORK ACCURACY	LOCAL ACCURACY
NAD 27	**1927-1986**	**10 Meters**	**First-Order (1 part in 0.1 million)**
NAD 83(1986)	**1986-1990**	**1 Meter**	**First-Order (1 part in 0.1 million)**
NAD 83(HARN)	**1987-1997**	**0.1 Meter**	**B-Order (1 part in 1 million)** **A-Order (1 part in 10 million)**
NAD 83(CORS)	**1994 -**	**< 0.01 Meter - Horizontal** **< 0.02 Meter - Ellipsoid Height**	

HIGH ACCURACY REFERENCE NETWORKS (HARN)



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NAD 83 READJUSTMENT

FIRST SURVEYS OF HARN COMPLETED BETWEEN 1987 AND 1997

GPS HEIGHT MODERNIZATION SURVEYS OF HARN
(1997 - 2003)

3-D ADJUSTMENT OF ALL HARN SURVEYS AND
OTHER SELECTED GPS SURVEYS COMPLETED IN FEB 2007

THIS ADJUSTMENT USED THE CORS NETWORK FOR CONTROL AND
IT REMOVED SMALL REGIONAL DISTORTIONS
(3 - 6 CM)

RESULTING REFERENCE FRAME IS CALLED
NAD 83 (NSRS2007)

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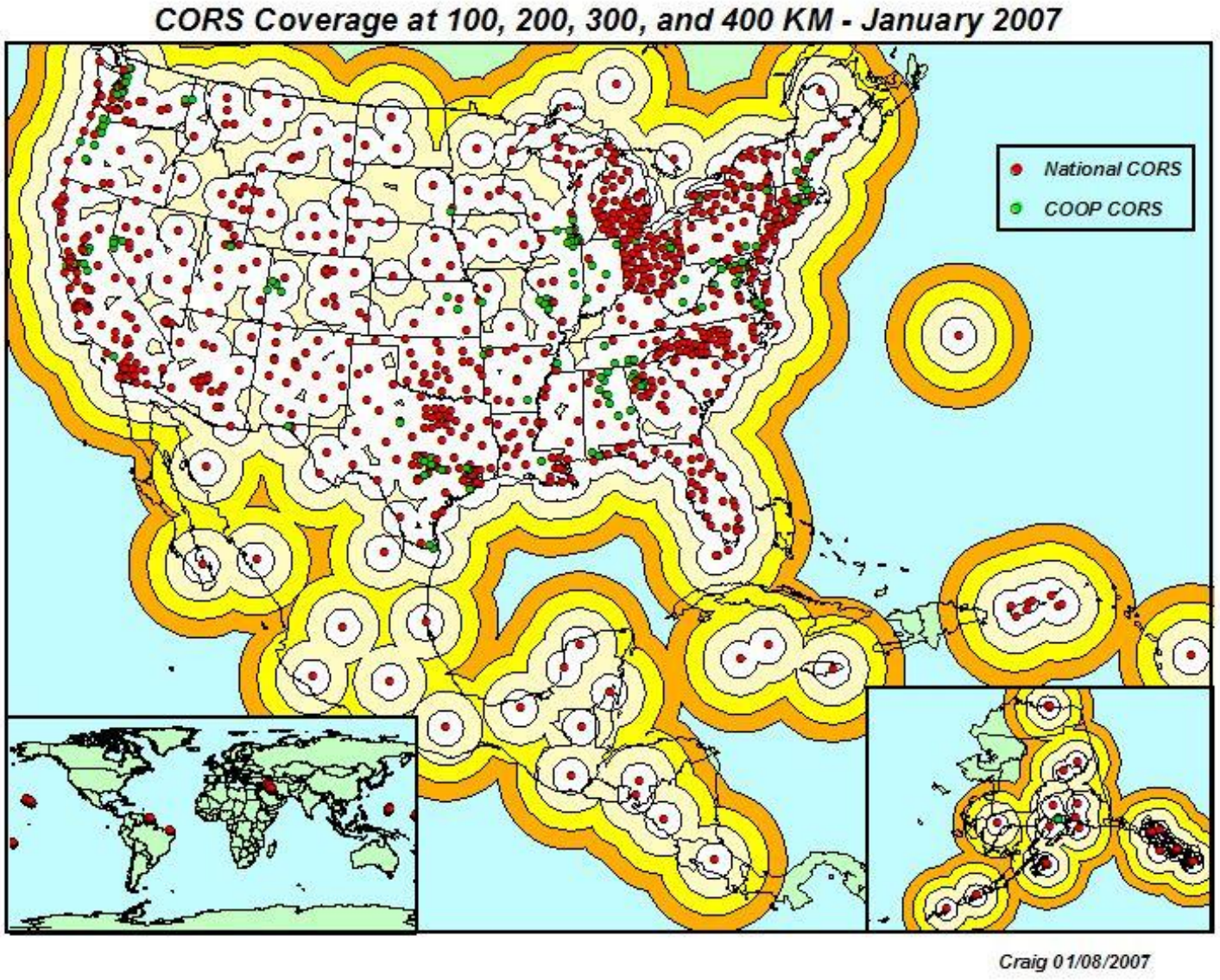
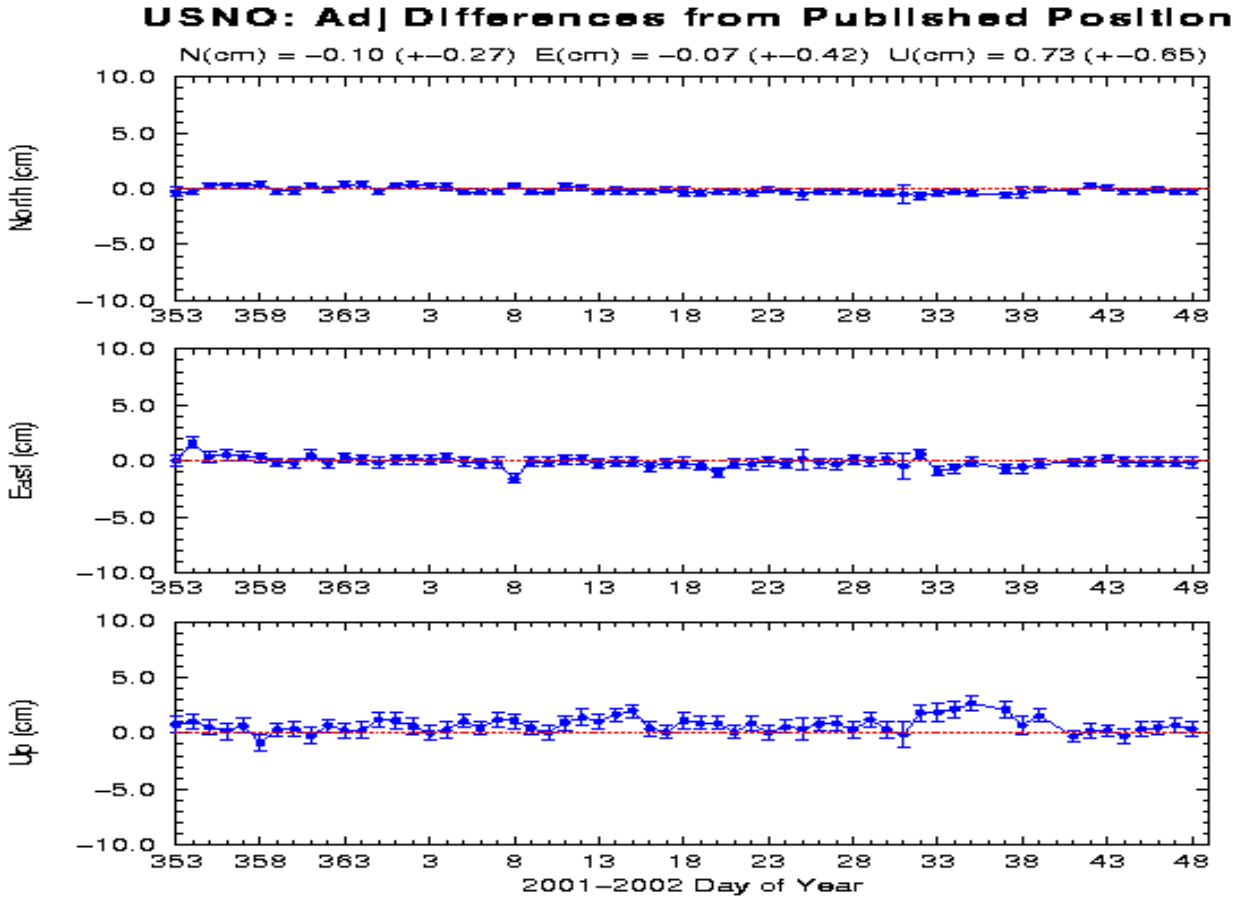
Continuously Operating Reference Stations



CORS ADVANTAGES

- 3-dimensional (Lat., Long., & Ellipsoid Ht. or X, Y, & Z)
- Eliminates control points reconnaissance (time and money).
- Eliminates needing people and equipment at a control points.
- Direct tie to National Spatial Reference System (NSRS).
- CORS positions and velocities are available in both NAD 83 and ITRF coordinate systems.
- CORS positions are of the highest accuracy.
- CORS positions are continuously monitored and will be updated if the site moves.

CORS DATA QUALITY



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Common Question

- CORS GPS hardware differs from our GPS hardware. Do we have to use only CORS with the same hardware?

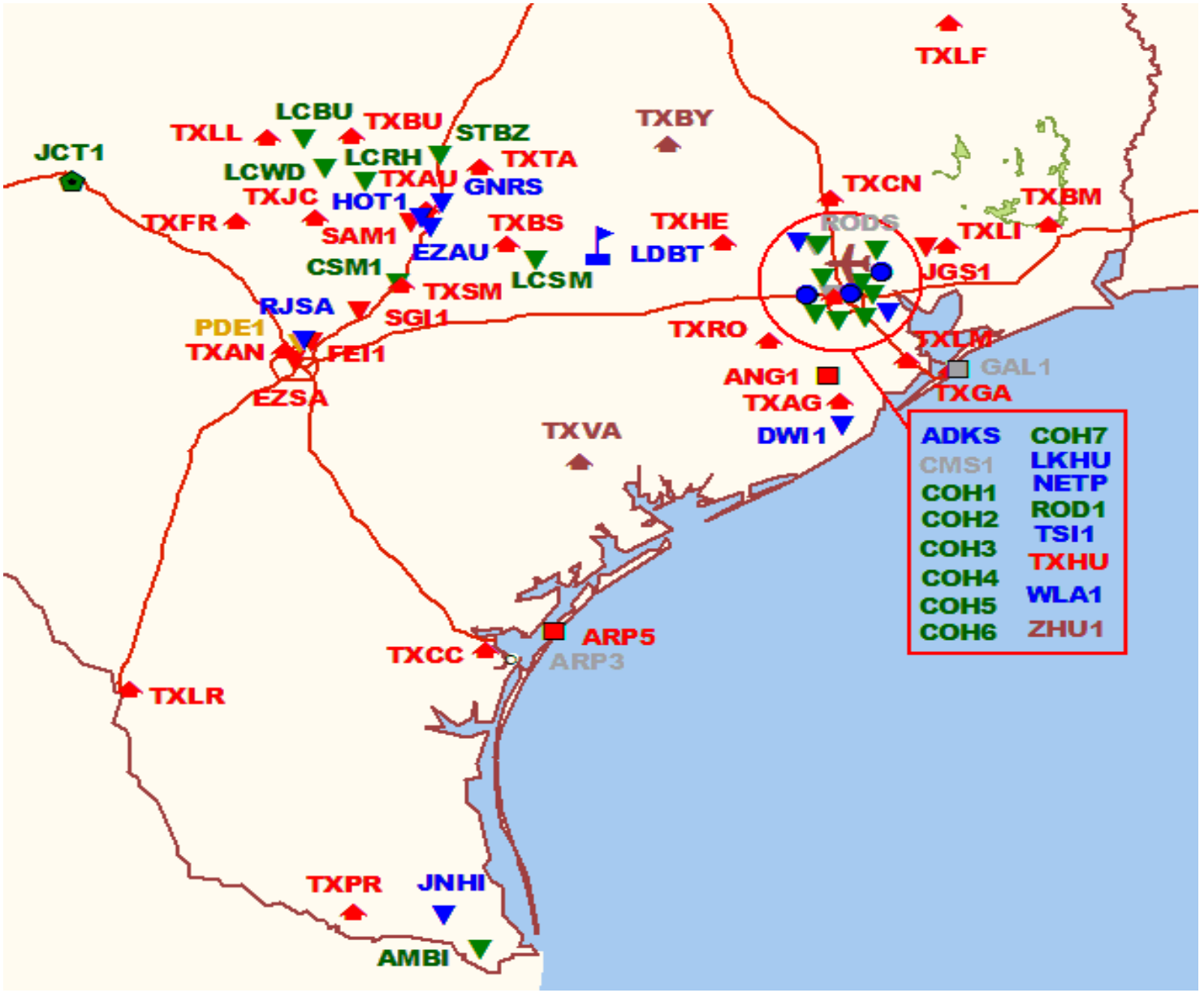
GPS Data – Rinex Format v2.20

- Data file spans
  - hourly, daily, customized (UFCORS)
- Data collection rates
  - 1sec, 5sec, 10sec, 15sec, and 30sec
- Data file life-time
  - hourly: 2 days + today
  - daily: permanently

Common Question

- The closest CORS to our project area is 50 miles away. How can we use CORS at this distance?

Regional CORS Coverage



TWO TESTS FOR POSITIONING PRECISION

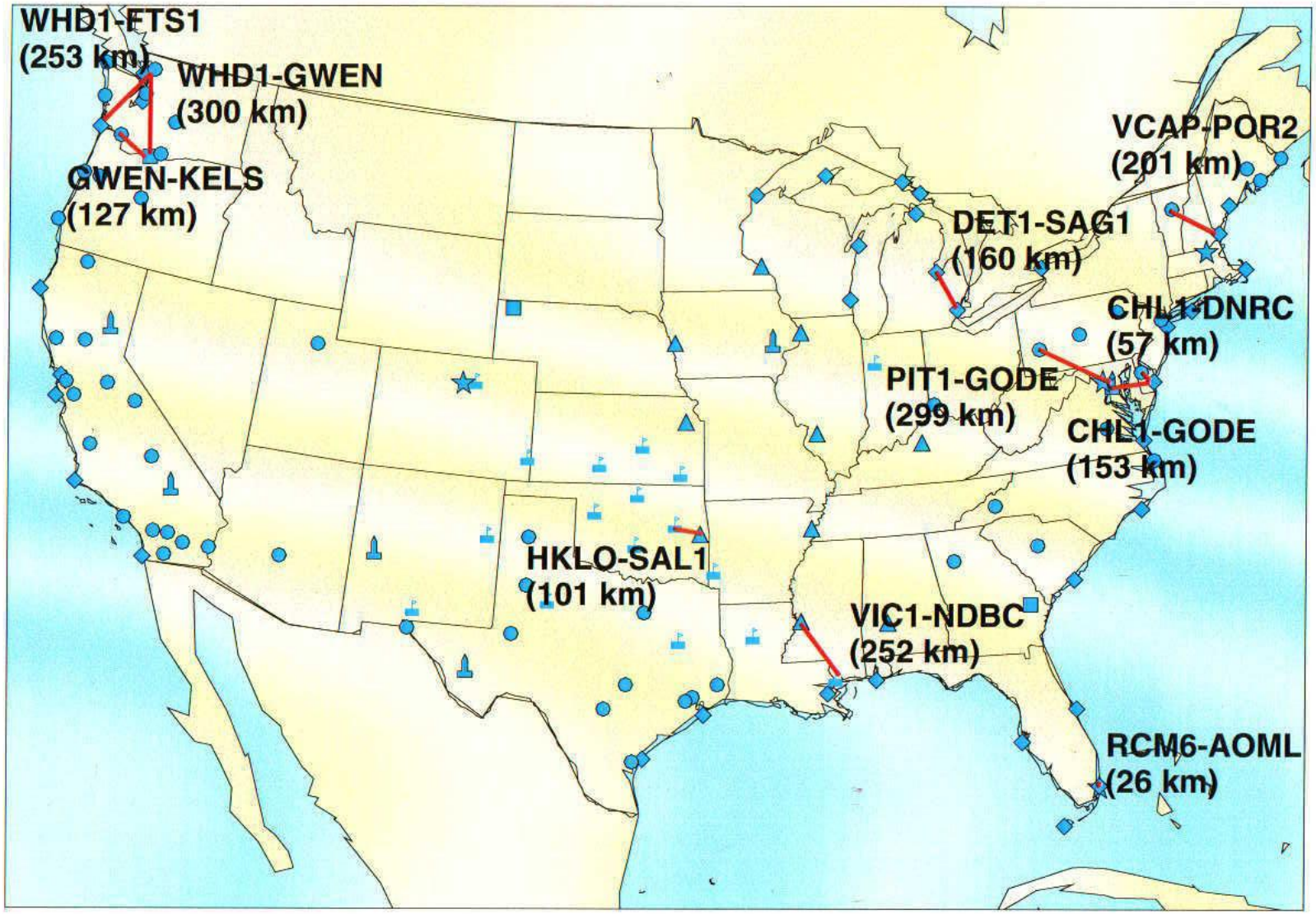
- Dual Frequency Carrier Phase
- Single Frequency Code

TEST DESIGN:
DUAL FREQUENCY CARRIER PHASE

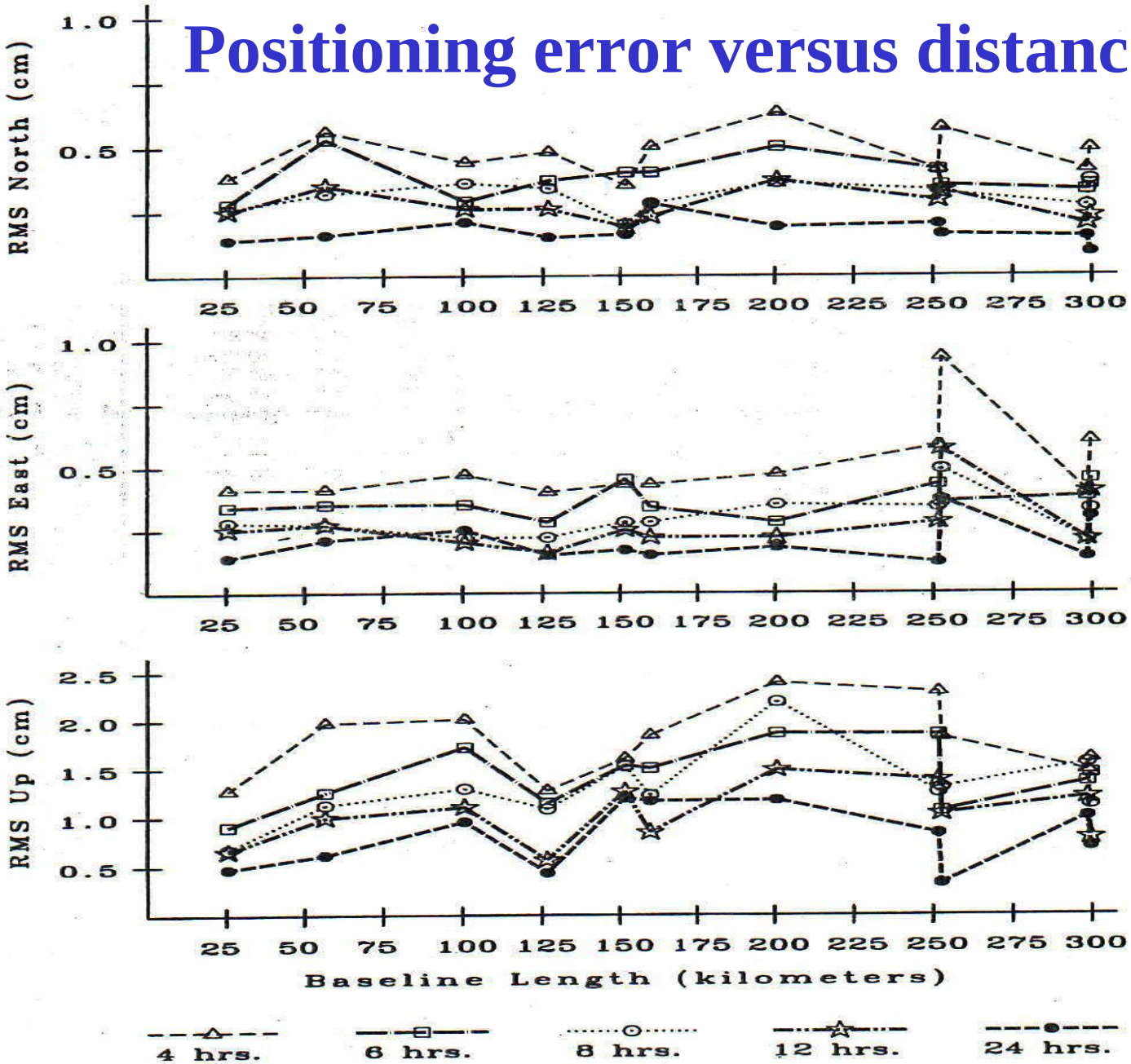
- Dual Frequency Geodetic Receivers
- Post-Processed with a Precise Orbits
- Pairs of CORS sites forming 11 Baselines
- Baseline lengths ranging from 26 to 300 km
- Various Observation Session Duration

(1, 2, 4, 6, 8, 12, and 24 hours)

BASELINES USED IN ACCURACY TESTS

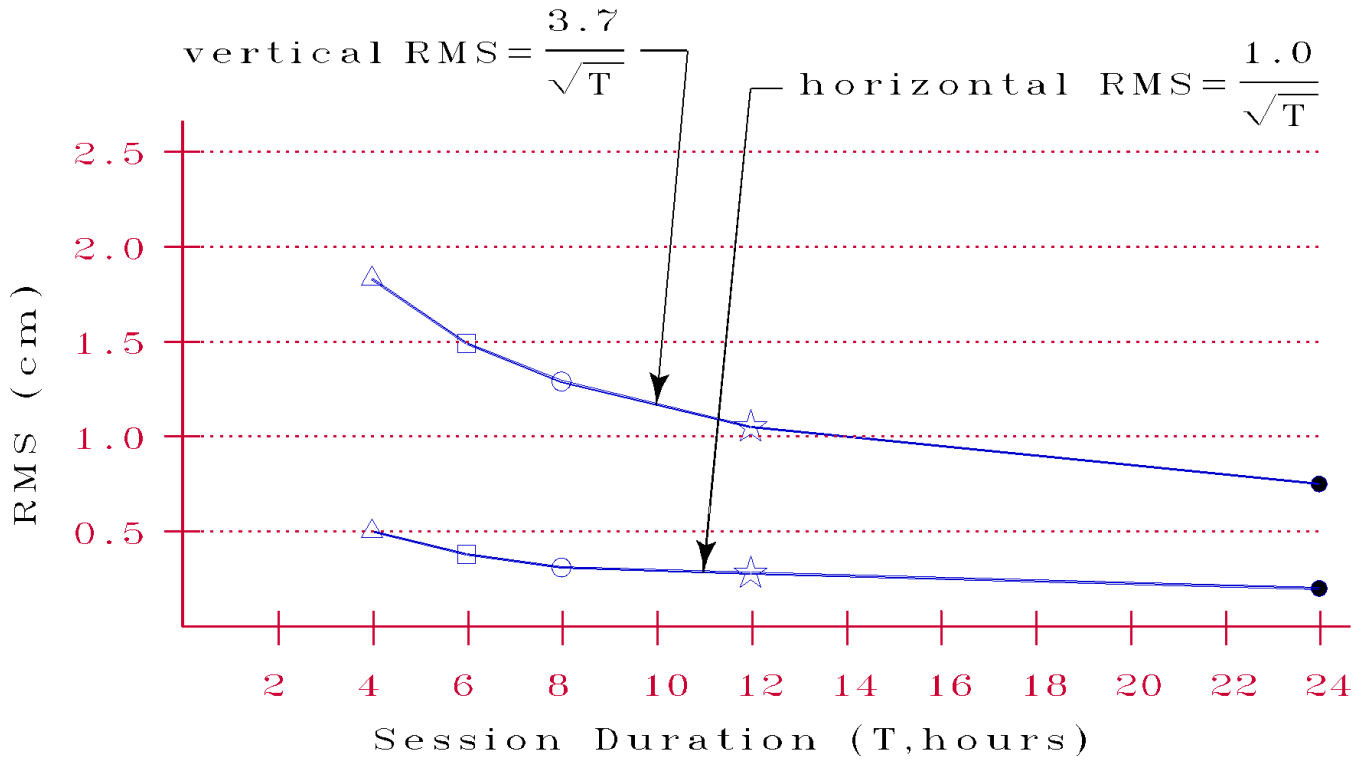


Positioning error versus distance



Positioning Error vs. Duration of the Observing Session

Dual-frequency GPS carrier-phase observations



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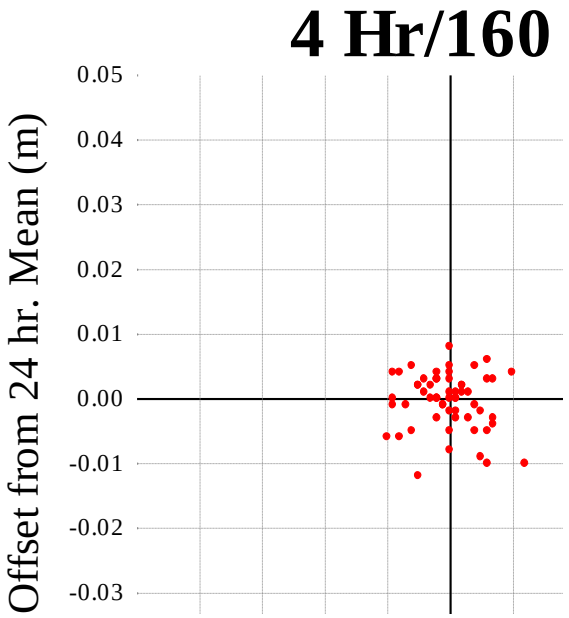
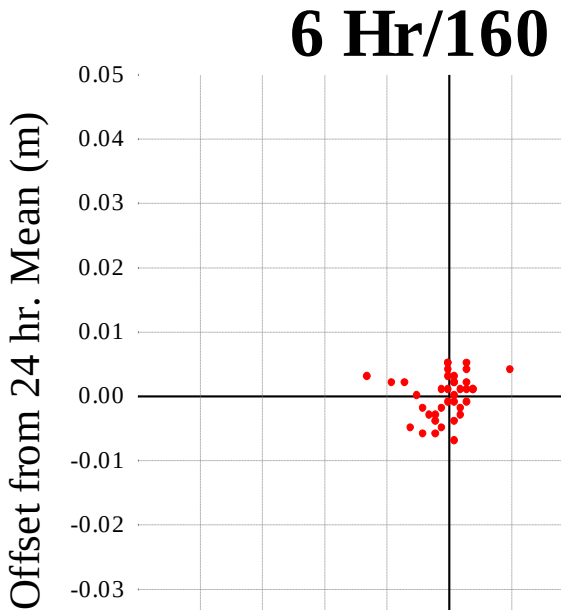
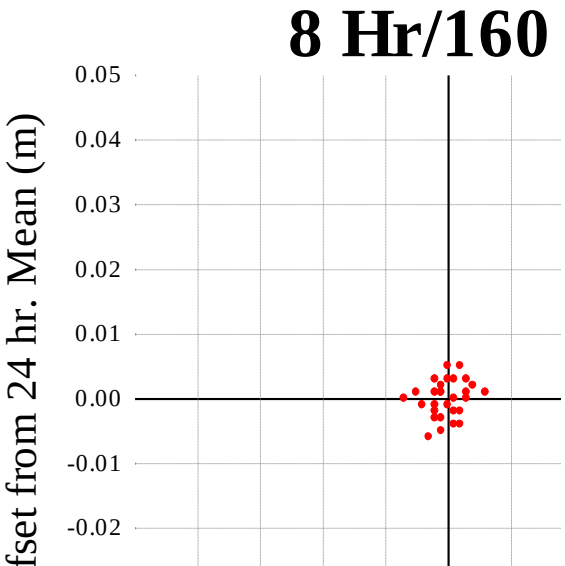
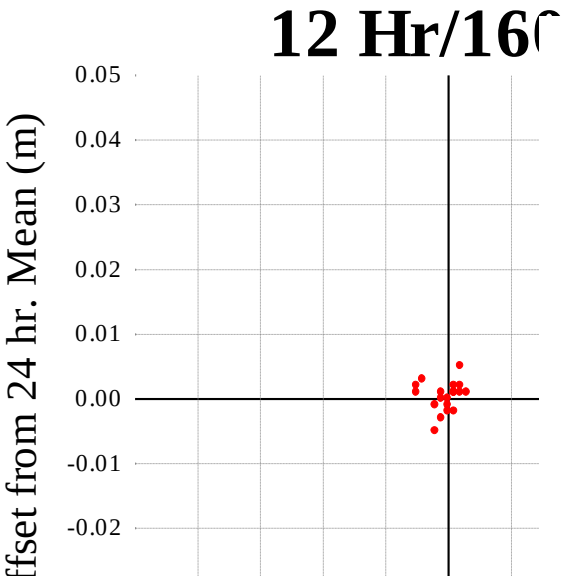
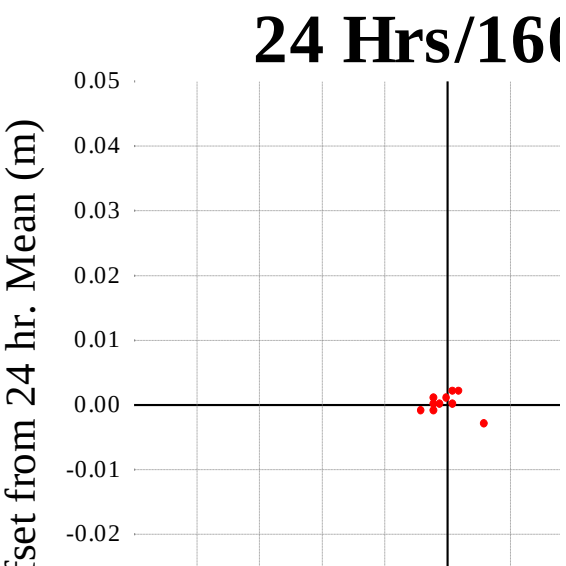
Time Scatter Plots (Horizontal)











Vertical Precision Using Dual-Frequency GPS Carrier Phase Observations 95% Confidence Level

COMMENTS

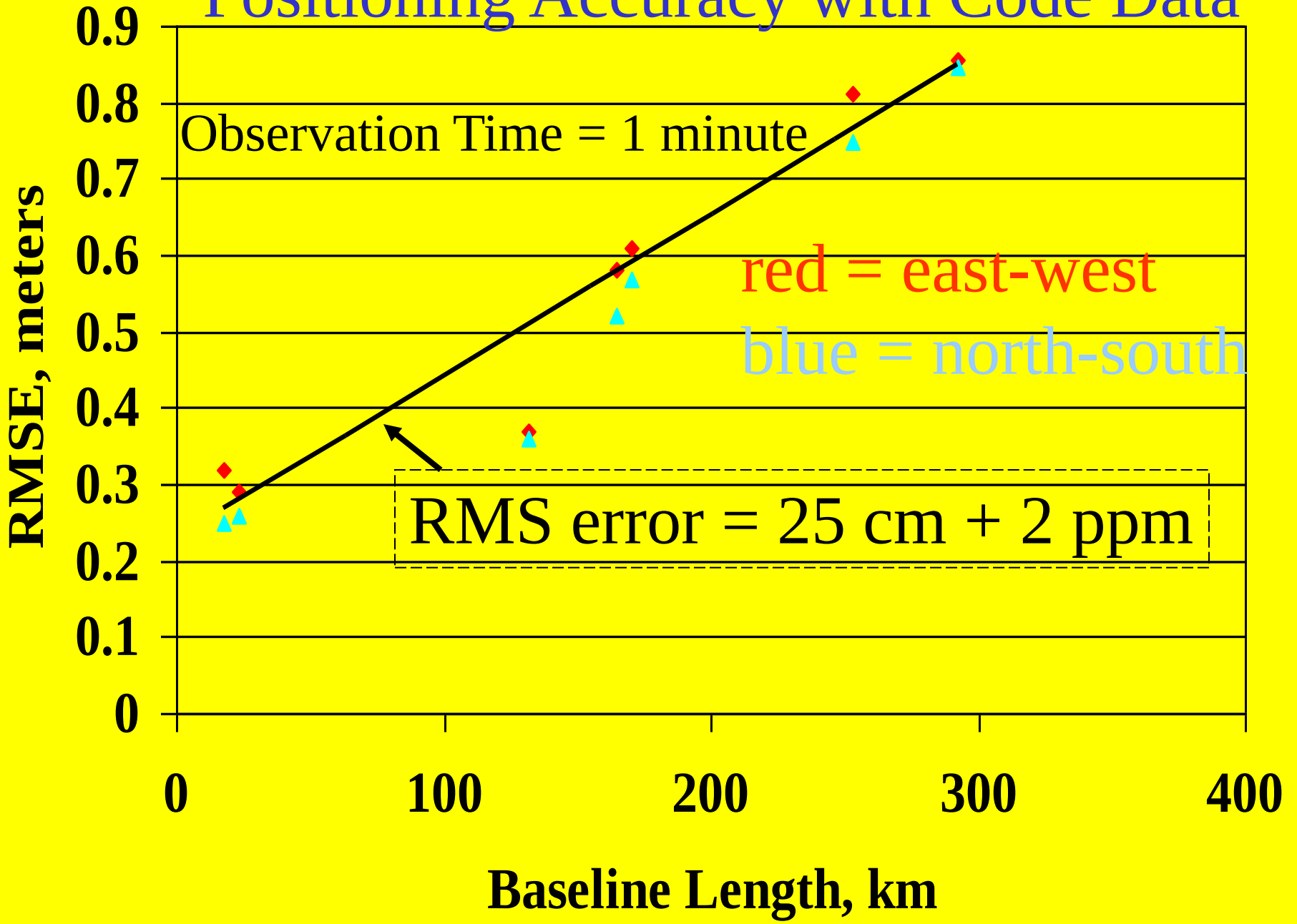
- Baseline lengths had little effect on the precision of the measurements

- Always use a precise ephemeris

TEST DESIGN: SINGLE-FREQUENCY CODE

- Positioned 12 points relative to each of seven CORS sites
- Baseline lengths of 18, 23, 132, 165, 170, 253, and 292 kilometers
- Observed 1-minute sessions at a 5-second record rate (interpolated CORS data from 30 to 5 seconds)
- Repeated experiment 4 times over a 2-day period

Positioning Accuracy with Code Data



COMMENTS

- Sub-Meter precision is possible with baseline lengths up to 300 kilometers

- This precision is possible using interpolated CORS data

- Most CORS data is available within 1-hour of the survey

SURVEYING METHODS

Kinematic GPS

Static Positioning (carrier phase)

Static Positioning (code)

SURVEY PROJECTS

- Photo Control
- Boundary Traverse
- Project Control
- Tree Location
- Utilities Survey
- Environmental Survey (Pond, Lake, Wetland)
- RTK Base Station Location
- Topographic Surveys
- Azimuth Pairs
- As-Builts
- Roughing in roads